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(54) IMPROVEMENTS IN OR RELATING TO FITTINGS FOR FLEXIBLE TUBINGS

(71) We, LEGRIS FRANCE S.A., a French Body Corporate, of 77330 OZOIR-la-FERRIERE, France, do hereby declare

the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates to fittings for reinforced, multi-layer flexible tube.

The fittings to be described are arranged to be used with flexible pipes of the type reinforced by a braided sheath and comprising at least three layers, viz. an inner tube, a braided sheath and a protective wearing layer.

The purpose of these fittings is to effect the virtually instantaneous connection of this type of tube to the fitting with a view to making considerable savings in manpower and to enable such fittings to be made by personnel having no special qualification therefor.

The connection of a reinforced multilayer flexible tube to previously proposed fittings is complicated and often requires bulky equipment, particularly for crimping and in any case the operation is always long, fairly delicate and expensive, and requires specialised and experienced manpower.

Fittings are known using a screw tight assembly, in which the inner part of the tube is mounted on a bush and the outer layer is strongly compressed under the effect of a tightening due to one of the following effects:

The effect of radial compression, by crimping, by collar, shells or compressed split rings;

The effect of compression obtained by annular rolling of axial type with formation of a retaining bead;

The effect of radial compression made by the extension by forcing of the inner diameter of the tubing under the effect of screw tightening the inner bush; and

The effect of axial annular compression on local swell of the tubing due to a reinforcement of the central bush, by screwing or unscrewing a nut.

It is also known to use devices for crimping on the outer wall of a body or indirect crimping of members which are integral with the body.

Devices have also been proposed in which additional members such as annular rings, incorporated with the locking and screwing members enable the screw tightening members to be rotated without the members holding the flexible tube being able to rotate at the same time.

In certain previously proposed devices, the bush supporting the inner wall of the flexible tube is separated from the body, is detachable, possibly rotatable and sometimes comprises an annular seal between said bush and the body of the fitting.

It has also been proposed to use devices allowing the instant fitting of a tubing simply by coupling said latter in the fitting. These are generally fittings with self-locking means in which a cone co-operates with annular parts self-locking on said cone, constituted by clips or split rings and having teeth for catching on the inner diameter, internally fluted or threaded segments or retaining rings or balls.

Other self-locking devices with radial tightening have also been proposed previously. However, almost all these self-locking devices which act as quick-fit fittings are provided for a homogeneous tubing of precise or calibrated dimensions and are not suitable for a multilayer flexible tubing.

In fact, the fittings are generally subjected to the pressure at the end of the tube and their seal is obtained on the outer diameter of the tube. Therefore, they cannot be suitable for a reinforced multilayer flexible tube which always requires that the seal be

made on the inner diameter and never on the end of the tubing. In fact, if the pressurised fluid arrives at the end of a multilayer flexible tubing, said fluid flows along the wires of the reinforcing braided sheath which is never perfectly embedded and incorporated in the layers of plastomer or elastomer, and causes the outer wear-resistant layer of low resistance to burst at low pressure, rendering the tube unaesthetic, dangerous and unacceptable to the user.

Among fittings, two devices have been proposed for which the seal is made on the inner diameter of the tubing and which would consequently be suitable for multilayer flexible tube; however, in reality, these two devices have been studied to replace and complete with the quick-fit fittings mentioned above.

They are therefore made for assembly on a semi-rigid, semi-supple or supple tube of fairly good calibration and are not suited for multilayer flexible tubings. In particular, the parts supporting the tightening efforts are not sufficient to withstand the considerable forces transmitted by the pressurised fluid and the forces of traction.

According to the invention, there is provided a quick-fit fitting for a reinforced, multilayer flexible tube having one end to be coupled to the fitting, the fitting comprising housing having a bore extending from a circular inlet of a diameter which is substantially equal to the outer diameter of the tube, a bead in the bore lying adjacent said inlet and extending radially inwardly to form a tube-gripping ridge followed by a generally conically expanding passage, a hollow bush located in said bore and having one end portion engaged in said end portion of the tube, an annular groove in the bore housing an annular seal which provides a fluid tight seal between the bush and the housing, said bush being movable axially of the bore in the body between a first position in which the bush is locked against rotation, relative to the housing to allow the tube to be inserted onto the bush, and a second position in which the portion of the tube on the bush is urged against the conical passage to prevent withdrawal of the tube from the inlet, but allowed to rotate with the bush relative to the housing.

According to the invention, there is further provided a fitting for a flexible tubing comprising a housing defining a through passage of generally circular cross-section, one end of the passage being arranged to receive the free end portion of a flexible tube, a hollow tubular member located within the through passage for rotary movement within the passage and longitudinal movement axially of the passage, sealing means providing a fluid tight seal between the housing and the member while allowing the relative rotary and axial movement between the housing and member, gripping means carried by that end portion of the member lying adjacent said one end of the passage, for entering a tube when the tube is inserted into said one end of the passage and for progressively expanding the diameter of the tube as insertion progresses, a portion of the passage adjacent said one end of the passage being tapered so as to increase in diameter with distance from the said one end of the passage whereby when the member is displaced towards said one end of the passage, any tube carried by the member will become trapped between the wall of the tapered portion of the passage and the gripping means, and locking means mounted on the member for engagement with a locking recess in the passage, when the member is displaced towards the other end of the passage to lock the member against further axial movement in the same direction and also against rotation whereby to facilitate the insertion of said tube into the gripping means, whereby upon pressurisation of the tube the member will tend to be displaced axially towards said one free end of the passage thereby allowing the member to rotate relative to the housing while at the same time clamping the tube between the member and the housing.

Fittings for a flexible tube and embodying the invention will now be described, by way of example, with reference to the accompanying diagrammatic drawings in which:

Figure 1 is a view in longitudinal section of an embodiment of an improved fitting according to the invention, in which the upper half view represents the fitting during fitting of the tube and the lower half view of the tube in the locked position;

Figure 2 is a view in longitudinal section of another embodiment of the fitting shown in Figure 1;

Figure 3 is a half-view in longitudinal section of another embodiment of the fitting in position of assembly of the tubing;

Figure 4 is a half-view in section of another embodiment in locked position of the tubing;

Figure 5 is a view in longitudinal section of a fitting screwed on a support member;

Figure 6 is a half-view in longitudinal section of another embodiment of a fitting when the tubing is assembled;

Figure 7 is a half-view in longitudinal section of another embodiment of a fitting in locked position;

Figure 8 is a half-view in longitudinal section of another embodiment of a fitting made of sheet metal in fitted position of the tubing;

Figure 9 is a half-view of another embodiment of the fitting with a body in one piece and in locked position;

Figure 10 is a view of the marking on one of the faces of the tubing;

Figure 11 is a view of the presentation of the tubing for assembly in the fitting;

Figure 12 is a view of the fit of the tubing in the fitting;

Figure 13 is a view of the tubing locked in the fitting;

Figure 14 is a half-view in longitudinal section of an embodiment of a fitting in assembled position;

Figure 15 is a half-view in section of the same fitting as Figure 14 in locked position;

Figure 16 is a half-view in section of another embodiment of the fitting in assembled position; and

Figure 17 is a view in section of the same fitting as Figure 16 in locked position.

Referring now to the drawings, Figure 1 shows a fitting having a housing which comprises a body 1 having a threaded part 23 on which is screwed a nut 7 which is in abutment against a shoulder 1*d* of the body in order to constitute a housing having an inlet bore 7*c* for a multilayer flexible tubing 8 constituted by at least three layers, viz. a plastics tube 8*c*, a braided sheath 8*b* and a wearing layer 8*a*. After the bore 7*c* there is provided a cylindrical housing 7*a* in which is mounted, in free rotation, a ring 6 which is axially held captive between the shoulder 1*d* of the body and a shoulder 7*b* of the nut.

The rotary ring 6 presents, near the bore 7*c*, a gripping ridge 6*b* extending radially inwardly, followed by a generally conical part 6*a*. Afrer the ring 6, the body has a bore 22 of diameter equal to the large diameter of the cone 6*a* and a tapped part 1*c* in which is screwed a ring 4 crimped at 1*h* and presenting a housing 4*a* in the form of a hollow hexagon. The ring 4 presents a shoulder against which abuts an O-ring 3 which is held on the opposite side by a ring 2 subjected to the action of a spring *r* in abutment against the end of a bore 1*b* provided in the body. Inside the fitting thus defined, there is mounted to slide and rotate a bush 5 having a tubular ferrule 5*c* guided in a bore 1*f* of the body, in the rings 2 and 4 and by the O-ring 3 forming seal and co-operating with a shallow groove 5*d*, said bush comprising in its median part a boss 5*b* in the form of a hexagon adapted to engage in the hexagonal housing 4*a* to ensure the locking of the bush 5 in rotation.

At the end opposite the tubular ferrule, the bush 5 has a ribbed ferrule having at least two ribs 5*a* on whic is engaged the end of the tubing 8. The bush 5 is immobilised in translation by the annular O-ring 3 engaged in the groove 5*d* of the bush and in rotation by the hexagonal boss 5*b* adapted to be engaged in the corresponding housing 4*a* of the ring 4.

The user having lubricated the end of the tubing 8 on the inside and outside, introduces said tubing into the bore 7*c* (top half-view of Figure 1) and pushes it against the gripping ridge 6*b* of the ring 6 so that the tube is compressed slightly to occupy the position 8*d* and then it takes its normal diameter again to be engaged on the ribbed ferrule of the bush 5 and surmount the sealing ribs 5*a* where it remains seized until the tubing 8 abuts at the end of the fitting on boss 5*b* of the bush. The fitting on the bush is obtained by alternately pushing and turning the tubing through 90° and 180°. During fitting, the bush 5 is immobilised in rotation and in translation due to the engagement of the hexagonal boss 5*b* in the corresponding housing 4*a* integral with the body.

The fitting is then locked, this being obtained by pulling on the tubing either manually or by a sufficient pressure of fluid exerted on the socket 5 which acts as a piston with the O-ring 3. This results in an axial displacement of the bush 5 which comes into the position shown in the bottom half-view of Figure 1.

The swollen part 8*e* of the tubing progressively bears on the cone 6*a* of the ring 6 and the tubing undergoes a gradually stronger radial, annular compression with wedge effect, since it is gripped between the bush 5 and the rotary ring 6.

When the limit of compressibility of the tubing is reached, the axial stroke stops in a position shown in the bottom half-view of Figure 1.

The pressurised fluid acting on the bush 5 and the O-ring 3, maintains a permanent axial thrust on the zone of seal of the channels, this allowing a constant tightness in time whatever the thermal cycles (within the limits authorised by the seal and the tubing). Ageing and hot creeping are therefore not to be feared.

The assembly constituted by the tubing 8, the bush 5 and the ring 6, may rotate, when the fitting is locked with or without pressure and this avoids any kinking of the tubing on assembly, and enables the fitting to be unscrewed from an apparatus, without dismantling the tubing, and re-assembly. In fact, the bush 5 being disengaged from the hexagonal housing 4*a*, it is no longer immobilised in rotation and the above-mentioned assembly may be animated by a rotary movement.

As shown in Figure 1, the spring *r*, by pushing the ring 2 on the O-ring 3, effects a permanent compensation of the seal of the O-ring. This arrangement is very useful when the extreme variations in temperature are considerable.

The annular seal 3 may present different forms apart from the O-ring shown and it may be constituted in particular by a lipped seal or anti-extrusion washers which can

resist high pressures.

Figure 2 shows a simplified version of the fitting which does not comprise any elastic compensation by means of a spring on seal 3. The seal 3 is mounted in a groove 1*a* machined in the body. The hexagonal housing 4*a* in which the boss 5*b* of the bush may engage for immobilising the bush 5, is made directly in the body 1.

The fitting shown in its fitted position in Figure 3 is constituted by an inexpensive, standardised body or carriage 19, of cylindrical external form, fitted in a bore of a ferrule 1 whose edge 1*u* is crimped to occupy the position 1*t* in a groove 19*b* of the body 19. This body or cartridge 19 may also be screwed and crimped or simply screwed on a ferrule 1 or an apparatus.

A seal 21 may be mounted between the body 19 and the ferrule 1 consistuted by an O-ring or a sealed bonding.

Furthermore the rotary ring 9 is made with a flange 9*c* which is engaged in a groove 19*a* of the body 19 and it is provided with a slot extending over half of its length, in order to render it elastic and thus to allow it to be forcibly fitted by elasticity in body 19. This assembly of the rotary ring 9 renders it irremovable and allows it to rotate.

Figure 4 shows, in locked position, a fitting which comprises a housing in the form of a monobloc body 1 in which is mounted a non-split rotary ring 9, which presents a groove 9*c* located opposite another groove 1*s* of the body 1 so as to form a toric housing in which is engaged an elastic retaining ring 18 ensuring the axial locking of the ring 9 but nonetheless allowing rotation thereof.

Figure 5 is a variant embodiment of the fitting of Figure 2 which constitutes a complete accessory adapted to be screwed on different known types of fittings to transform them into instant fittings for multilayer tubings.

To this end, a sufficiently long nut 7 is used, screwed on a threading 18 of a body 1 of fitting of known type, said nut 7 internally receiving a screwed sleeve 10 which presents a bore 10*b* and a hexagonal housing 10*d* identical to the housing 4*a* of Figures 1 and 2 and of which the shapes in contact with the fitting 1 are complementary thereof. The top half-view of Figure 5 shows a conical fitting 10*a* with cutting ring or conical bush. The bottom half-view of Figure 5 shows a so-called compression fitting with its radius 1*l* and its guide 1*k*.

The assembly of parts 10 or 11 of the bush 5 of the seal 3 or 11*a* of the rotary ring 6 and the nut 7 forms a complete accessory which may be used without modification.

This assembly may be mounted on cutting ring, compression, collet or flat face fittings.

The rotary ring 6 comprises a gripping ridge 6*b* and a conical part as described hereinabove; however, there are provided on the cone two catching teeth 6*c* and 6*d* on which the tubing catches and is locked after determined axial stroke and compression.

Of course, it is possible to provide one or more teeth on the ring 6.

Figure 6 shows a fitting in which the body 1 comprises a tapping 20 in which is engaged a hollow screw 12 which replaces the nut 7 and the rotary ring 6.

In order that the tubing in locked position may rotate in working position, the cone 12*a* and the gripping ridge 12*b* are subjected to an anti-adherent surface treatment which replaces the rotary ring 6.

To avoid the bush 5 escaping with the tubing, by an excess of sliding, a flange 5*e* is provided on the bush 5, so that said flange 5*e* comes into abutment on the screw 12.

Figure 7 shows a variant embodiment of the fitting of Figure 6, in locked position, in which the flange 5*e* is replaced by a washer 13 abutting on the boss 5*b* of the bush.

The monobloc body 1 receives a rotary ring 15 held by a washer 14 on which a crimped edge 1*m* of the body 1 is bent.

Figure 8 shows another embodiment of a fitting in locked position which comprises a tubular end 1*s* adapted to be fixed in the majority of the known fittings (with cutting ring, compression, etc...)

The body 1 has a tapping 20 in which are screwed a ring 16 having a hexagonal housing 16*a* adapted to receive the boss 5*b* of the bush 5 and a piece 17 made from stamped sheet metal. Inside the piece 17 is mounted a rotary piece 17*c* made of thin sheet metal, guided in the cone 17*b* and in abutment against the gripping ridge 17*a*.

Figure 9 shows another embodiment of a fitting in locked position which comprises a monoblock body 1 internally provided with the different bores and housings shown in Figure 2 which may be made either by turning and boring directly with an outer from 1*p* and an inner from 1*q*, or by cutting-off, reserving a thin tubular part 1*n* adapted to be shaped to present the final form 1*q* and 1*r*.

At the other end of the body 1, the general shape is cylindrical with a groove 1*t*. This shape is adapted for a direct assembly in fittings of the female type.

Figures 10, 11, 12, 13 show a method of verifying that the tubing has been correctly fitted in the fitting, said method enabling the depth of fit and the locking to be checked.

Figure 10 shows a tubing 8 on which are printed several series of marking signs, a first series of arrows 8*f* indicating the direction of fit of the tubing in the fitting; a second series of transverse lines 8*d* regularly spaced apart by a distance A which corres-

ponds to the length to be fitted, and a third series of square marks 8*e* spaced by a distance B from the lines 8*d* and which gives the stroke of locking.

The same marking is made on the opposite side on the tubing but in the reverse direction for assembling the other end.

When the tubing is to be fitted, it s firstly cut along line 8*d* as shown in Figure 10 to separate the unwanted part 8*g*.

The tubing being internally and externally lubricated, it is fitted as described previously until the line 8*d* (Figure 12) is flush with the fitting, so that the fitting is correct and checked.

Locking is then effected by pulling on the tubing 8 until the square mark 8*e* is flush with the fitting 7 as shown in Figure 13.

This method thus makes it possible to check whether the locked position is correct.

If there is any doubt concerning the assembly, the cycle may be started again by pushing the tubing to check the fit and pulling it to verify the locking thereof.

If the pressure of the fluid is sufficient, locking is effected automatically under the pressure of the fluid; it is then sufficient to check the appearance of the square mark 8*e* whose stroke B in minimum.

If the tubings do not or could not comprise any marking, it is possible to provide on the outside of the fitting a mark 24 for checking the fit of the tubing and a mark 25 for checking the locking. The user having a non-marked tubing makes the marks on the tubing himself by means of a marking member and using marks 24 and 25 which figure on the fitting to determine the distance A for fit and distance B for locking.

The described fittings can be used with all multilayer flexible tubings having a sufficient possibility of "tightening" and "extension" for their differences in diameter to be fairly large to permit the automatic manual assembly without excessive efforts.

This type of fitting is used for automobile braking tubing, braided PVC tubings, much used on machines for water, lubricating liquids or coolants (oils, soapsuds, emulsion), used also for sprinkling, for dispensing liquid foodstuff, for compressed air, agricultural treatment and hydraulic servo-control.

However, this fitting device is used with multilayer flexible tubings having a sufficient possibility of tightening and extension for the differences in diameters obtained to allow locking.

However, it is has been ascertained that this fitting may be used with tubings of greater rigidity, particularly multi-layer high pressure tubings in which there is little possibility of extension and tightening.

The following embodiment has for its object an improvement in the fitting, enabling tubings of greater rigidity to be used.

The fitting shown in Figures 14 and 15 comprises, as in the preceding embodiment, a body 1 on which is screwed a nut 7 having a cylindrical housing 7*a* in which is mounted a rotary ring 6 which is axially held prisoner between a shoulder 7*b* of the body and an elastic ring or clip 27 engaged in a groove 6*c* in the rotary ring.

The rotary ring 6 has an inlet bore 6*e* of a flexible multi-layer tubing 8, a bead 6*b* forming constriction, extending radially to the outside, followed by a generally conical portion 6a.

Furthermore, the body 1 presents a housing 30 in the form of a hexagon followed by a tapped hole 1*c* in which is screwed a ring 4 against which abuts an anti-extrusion washer 2 and an O-ring 3 disposed in the housing 1*a* of the body 1.

Inside the fitting thus defined is slidably and rotatably mounted a bush 5 having a tubular ferrule 5*c* guided over its whole length in a bore 1*e* of the body, by the O-ring 3, the washer 2 and the ring 4, said bush comprising in its median part a boss 5*b* in the form of a hexagon adapted to engage in the hexagonal housing 30 to ensure locking of the bush 5.

At the end opposite the tubular ferrule, the bush 5 presents a channeled ferrule having channels 5*a* and a channel or tooth 5*g* of larger diameter than channels 5*a* on which the end of the pipe 8 is engaged.

Following the tooth or channel 5*g* there is provided a groove 5*e* in which is mounted an O-ring 28 in contact with the inner surface of the tubing 8. A rounded part 29 provided on the bush 5 between the groove 5*e* and the boss 5*b* is adapted to receive the end of the tubing 8 when said latter is tightened, as shown in Figure 15.

A split ring 26 is interposed between the conical portion 6*a* of the ring 6 and the outer surface of the tubing 8, said ring being provided externally with a conical portion 26*a* cooperating with the conical portion 6*a* and internally with a series of teeth or channels 26*b* adapted to be engaged in the outer wall of the tubing 8. The ring 26 has at least two longitudinal slots such as 26*f* which give it suitable elasticity for assembly on the tubing 8.

The ring 26 is adapted to come into abutment against a shoulder 6*d* of the rotary ring 6.

The split ring 26 which allows the tubing 8 to be assembled is driven during the period of locking of the tubing by the tubing itself, along the conical portion 6*a*, this tightening the ring 26 on the tubing by its teeth or channels 26*b*, so that the tubing is securely gripped between the channels or teeth 5*a* and the channels or teeth 26*b*. This powerful

tightening effort is calculated as a function of the tubing, its thickness and its actual capacity of compression. The longitudinal stroke of the bush 5 and of the tubing 8, the angle of the conical portion 6*a* are provided to obtain the effort and compression necessary for the tubings used.

The bush 5 presents a large outer diameter preventing ejection thereof, and it may come into positive abutment axially with the ring 6.

The assembly as shown in Figures 14 and 15 is intended to allow a permanent axial thrust on part 8*f* of the tubing. Furthermore, this fitting may be used with tubings allowing a slight extension along 8*e* of the tubing, due to the presence of a tooth 5*g* of larger diameter than the teeth or channels 5*a*.

Figures 16 and 17 show another embodiment of the fitting in which the rotaty ring 6 has been eliminated and the conical portion 7*f* is made directly in the nut 7, so that the ring 26 is in contact, by its conical portion 26*a*, with the conical portion 7*f*.

As in the preceding embodiment, the split ring 26 tightens the tubing 8 by its teeth 26*b* and has slots 26*f*.

The fitting shown in Figures 16 and 17 is used more particularly for assembling a tubing 8 which has virtually no possibility of extension.

The bush 5 comprises a flange 5*f* against which abuts the end 26*e* of the ring 26, the other end of which is adapted to abut against the shoulder 7*e* of the nut 7.

As in the preceding embodiment, the tubing 8 is manually mounted by force on the bush 5, whilst the boss 5*b* is engaged in the housing 30 and locking is effected by pulling on the tubing 8 which drives the bush 5 whose flange 5*f* comes into abutment against the end 26*e* of the ring 26 displacing said ring in the direction of the conical portion 7*f* of the nut 7, so that the end of the tubing 8 is held compressed between the bush 5 and the ring 26. Locking stops when the split ring 26 comes into abutment against the shoulder 7*e*.

In this case, the conical portion 7*f* and part 7*h* comprise an anti-adherent coating allowing easier rotation and locking of the tubing.

As the bush 5 extends by its tubular ferrule 5*c* in the bore 1*e* of the body, it is possible to push the brush axially by said ferrule 5*c* in order to proceed with locking. This operation may be effected manually, by means of a jack or a threaded part. In this case, locking is energetic and complete, which may be highly advantageous for the mass manufacture of high pressure flexible tubings.

Verification, checking and locking of manufactured flexible tubings may be effected by drawing on a traction machine.

The described fittings allows a virtually instant fitting of the multilayer flexible tubings.

Furthermore, the considerable importance of flexible tubes for fluids under pressure and the increasing part played by servo-controls by means of fluids is realised in industry, this resulting in any improvement in the costs of establishing the fittings of multilayer flexibles rendering the use thereof easier and more current.

In the fittings described a bare flexible tube is used, without any preparation other than its being cut to length, to the exclusion of any other preparation such as removal of the braid.

Fitting consists simply in forcibly pushing the previously lubricated tube with reciprocating and rotating movements (thrust with alternate sectorial rotations of 90° to 180°) to the end of the fitting. Locking in permanent position of functioning is then effected, either by pulling on the tube (thus enabling its correct holding to be checked) or by placing it under a sufficient pressure for this locking to be effected automatically.

The fitting presents a self-holding of the tubing and a permanent self-seal due to the pressure itself, and preventing any leakage by creeping or loss of tightening of the tubing in time or as a function of the influences of hot or cold thermal cycles.

The fittings described ensure the rotation of the tube in the fitting, thus avoiding the kinking thereof and enabling the fitting and its tube to be unscrewed or re-screwed on any apparatus.

The fittings described are either in the form of independent fittings, or in the form of a complete accessory screwing on the majority of standard fittings available on the market, (with cutting ring, compression, collet and flat face, for example) and transforming said fittings into instant connecting members for multilayer flexible tube or in the form of an inexpensive, standardised, cylindrical part forming a cartridge, said part being able to be fitted by crimping or screwed and crimped or simply screwed in a very simple, inexpensive body or directly screwed in an apparatus, either in the form of a fitting terminated by a tubular part of internal dimensions equal to those of the tubing and entering directly one of the conventional known fittings, or in the form of a fitting terminating in a part having forms complementary of a known instant fitting.

To check the correct assembly of the tubing different marks printed on the tube intself allow the tube to be cut at the suitable spot and the correct length of fit thereof in the fitting to be checked as well as the locking stroke, in order to check the assembly without any loss of time.

Two symmetrical markings are made on the tube, one on one side for the fit at one of the ends of the tube and the other on the opposite side for the fit at the other end.

The tubing undergoes reversed stresses of tightening and extension, offset axially during the assembly of the tubing, but these stresses are then combined at one spot by axial displacement of the tubing and the bush to the outside of the tubing up to a permanent position of locking. The axial displacement effects at first a progressive annular radial compression, with wedge effect, of the tubing between the bush and the rotary ring; after a calculated axial stroke, there is then produced a premanent locking due to the limit of compressibility of the tubing and also if need be by means of catching teeth on a ring locking the tubing after a determined axial stroke and compression of the tubing. The compression and locking of the tubing are maintained under constraint by the pressurised fluid which premanently pushes the bush.

WHAT WE CLAIM IS:

1. A fitting for a reinforced, multilayer flexible tube having one to be coupled to the fitting, the fitting comprising a housing having a bore extending from a circular inlet of a diameter which is substantially equal to the outer diameter of the tube, a bead in the bore lying adjacent said inlet and extending radially inwardly to form a tube-gripping ridge followed by a generally conically expanding passage, a hollow bush located in said bore and having one portion engaged in said end portion of the tube, an annular groove in the bore housing an annular seal which provides a fluid tight seal between the bush and the housing, said bush being movable axially of the bore in the body between a first position in which the bush is locked against rotation, relative to the housing, to allow the tube to be inserted onto the bush, and a second position in which the portion of the tube on the bush is urged against the conical passage to prevent withdrawal of the tube from the inlet, but allowed to rotate with the bush relative to the housing.

2. A fitting and tube according to claim 1, wherein the bore has a reduced diameter section containing a recess having at least one flat surface, and wherein the bush has a projection having at least one corresponding surface, the projection of the bush engaging the recess when the bush is in the first position to lock the bush against rotation.

3. A fitting according to claim 1, wherein the end part of the bush is axially immobilised by the annular seal.

4. A fitting according to any one of claims 1 to 3, wherein the housing includes a body and an annular member defining said gripping ridge and the conical passage, said annular member being axially immobilised but allowed to rotate freely inside the body.

5. A fitting and tube according to claim 4, including a nut screwed onto the body to effect the axial immobilisation and enable the free rotation of the annular member.

6. A fitting according to claim 4, wherein the annular member is split longitudinally over a part of its length and carries a catching tooth which is engaged in a groove in the body in which it is mounted.

7. A fitting according to claim 4, wherein the annular member is axially immobilised by a ring engaging facing grooves in the body and the annular member.

8. A fitting according to any one of claims 4 to 8, wherein the annular member includes a stop for limiting the axial travel of said tube therealong.

9. A fitting according to any one of claims 4 to 8, wherein the outer circumferential surface of the annular member is treated with an anti-adherent to enable to the member to rotate relative to the body.

10. A fitting according to claim 1, wherein the housing includes a body and a member of stamped sheet metal, defining the inlet, the gripping ridge and the conical passage and a locking ring for locking the tube against rotation when the bush is in the first position, the stamped member being in screw threaded engagement with the body and arranged to trap the locking ring between itself and the body.

11. A fitting according to claim 1, wherein the housing includes a body and an annular member defining said inlet and the gripping ridge is axially immobilised by a stop washer crimped onto the body.

12. A fitting according to claim 1, wherein the housing comprises a body and wherein the inlet, the gripping ridge and the conical passage are machined into the body, said conical passage having a non-stick coating.

13. A fitting according to any preceding claim, and a reinforced multilayer flexible tube, wherein the bush has a flange at a location remote from the tube, the flange having a diameter larger than that of the gripping ridge and at least equal to the inner diameter of the expanded tube.

14. A fitting and tube according to claim 13, wherein the bush carries a washer having a diameter larger than that of the gripping ridge and at least equal to the diameter of the expanded tubing.

15. A fitting according to any preceding claim, wherein the housing is of generally cylindrical configuration and has an outer circumferential groove to enable the housing to be readily coupled to an apparatus.

16. A fitting and tube according to any one of claims 1 to 14, wherein the housing includes a body in the form of an elongate

nut in screw threaded engagement with a sleeve defining said annular groove and housing said annular seal.

17. A method of coupling a tube to a fitting according to claim 1, comprising the steps of lubricating the free nd portion of the tube, inserting the free end portion of the tube into the inlet, imparting to the tube alternate axial and rotary movements to cause the tube to be compressed on the gripping ridge and thereafter to engage the bush to displace the bush into the first position where the bush is prevented from rotating, continuing the said movements to cause the tube to expand over the outer surface of the bush and to travel along the bush to a predetermined extent, causing the tube to be displaced axially of the housing in the opposite direction, either manually or by the application of fluid under pressure to the bush, to wedge the tube between the housing and the bush and thereby lock the tube to the fitting.

18. A method of checking the assembly of a tube in a fitting according to claim 1, comprising the steps of marking the tube with a plurality of equidistant cutting lines, marking the tube with a plurality of arrows indicating the direction of fit for the adjacent end of the tube, and marking the tube with indicating marks indicating a distance from each cutting line, in the opposite direction to that of the arrows, corresponding to the length of tubing to be clamped within the fitting, thereafter cutting the tube along a cutting line, inserting the cut end of the tube into the fitting until the first cutting line is flush with the fitting inlet, withdrawing the tube from the fitting and repeating the operation if when the tube is locked during withdrawal thereof an indicating mark is not flush with the fitting inlet.

19. A method according to claim 18, including the step of marking the outside of the fitting with a mark indicating the exact stroke of fit and a mark indicating the locking stroke.

20. A fitting according to claim 1, wherein the housing includes a body and a split ring located between the wall of the conical passage and the outer surface of the tubing which engages on the bush, said ring having an outer conical surface for co-operating with the conical passage of the body and a plurality of teeth on its inner surface arranged to bite into the outer wall of the tube.

21. A fitting according to claim 20, wherein the ring has at least two longitudinally extending slots.

22. A fitting according to claim 10 or to claim 21, wherein the body has a shoulder against which the ring is adapted to abut.

23. A fitting according to any one of claims 20 to 22, wherein the bush has a portion having an outer diameter sufficiently great to prevent ejection of the bush from the body and wherein the bush is arranged to be in positive axial abutment with the ring.

24. A fitting according to any one of claims 20 to 22, wherein the bush has a collar arranged to abut the ring.

25. A fitting according to any one of claims 1 to 16 and 20 to 24, wherein the bush as a flared portion which is engaged by the end of the tube when the tube is clamped between the bush and the housing.

26. A fitting according to any one of claims 1 to 16 and 20 to 25, wherein the bush has an annular groove in its outer surface accommodating an O-ring which O-ring is in contact with the inner surface of the tube.

27. A fitting according to claim 26, wherein the O-ring is mounted on the bush with an anti-extrusion washer.

28. A fitting according to any one of claims 20 to 24, wherein the ring has a conical portion provided with an external annular groove accommodating a clip in abutment with the body.

29. A fitting according to any one of claims 1 to 16, and claims 20 to 28, wherein the bush extends substantially the whole length of said bore.

30. A fitting for a flexible tubing comprising a housing defining a through passage of generally circular cross-section, one end of the passage being arranged to receive the free end portion of a flexible tube, a hollow tubular member located within the through passage for rotary movement within the passage and longitudinal movement axially of the passage, sealing means providing a fluid tight seal between the housing and the member while allowing the relative rotary and axial movement between the housing and member, gripping means carried by that end portion of the member lying adjacent said one end of the passage, for entering a tube when the tube is inserted into said one end of the passage and for progressively expanding the diameter of the tube as insertion progresses, a portion of the passage adjacent said one end of the passage being tapered so as to increase in diameter with distance from the said one end of the passage whereby when the member is displaced towards said one end of the passage, any tube carried by the member will become trapped between the wall of the tapered portion of the passage and the gripping means, and locking means mounted on the member for engagement with a locking recess in the passage, when the member is displaced towards the other end of the passage to lock the member against further axial movement in the same direction and also against rotation whereby to facilitate the insertion of said tube into the gripping

means, whereby upon pressurisation of the tube the member will tend to be displaced axially towards said one free end of the passage thereby allowing the member to rotate relative to the housing while at the same time clamping the tube between th member and the housing.

31. A fitting for a flexible tube substantially as hereinbefore described with reference to any one of Figures 1 to 9 and 14 to 17 of the accompanying drawings.

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1603670 COMPLETE SPECIFICATION

4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

FIG.1

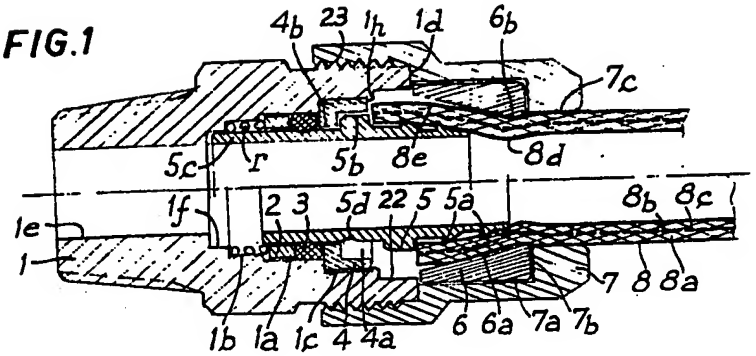


FIG. 2

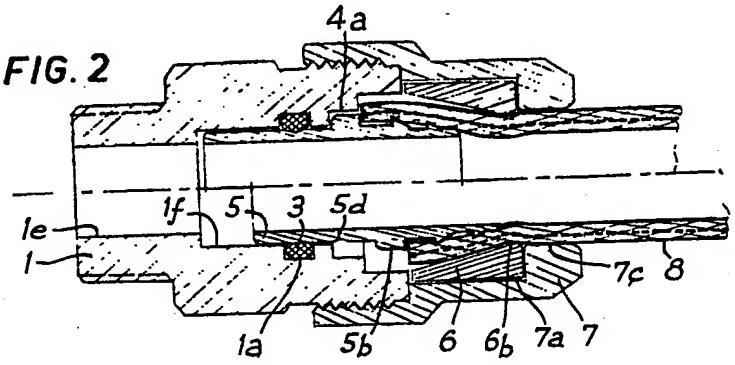


FIG.3

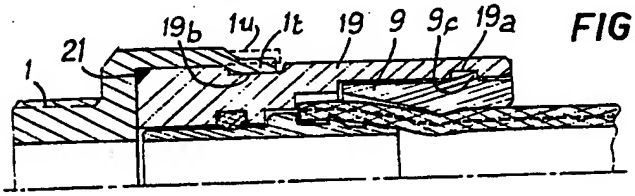
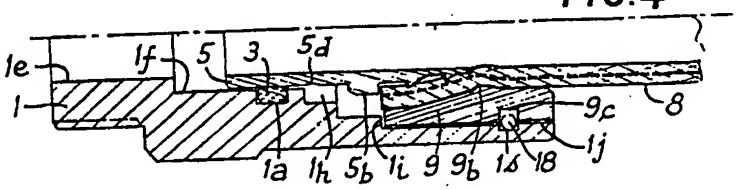


FIG.4



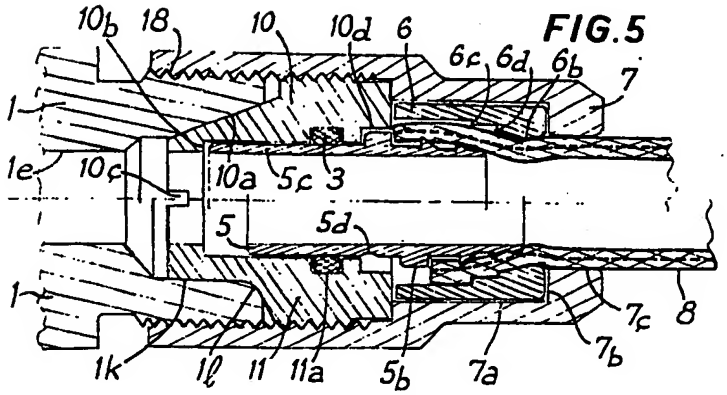


FIG.5

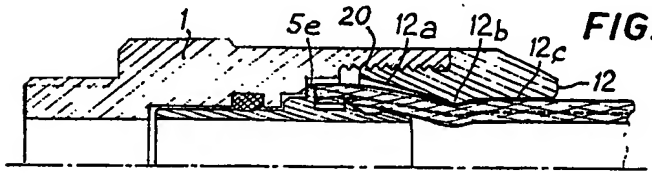


FIG.6

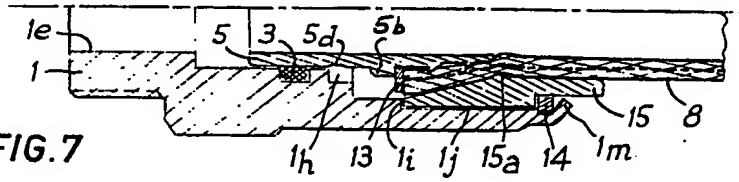


FIG.7

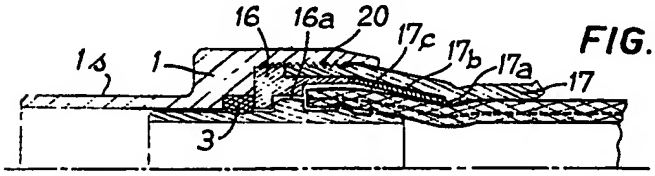


FIG.8

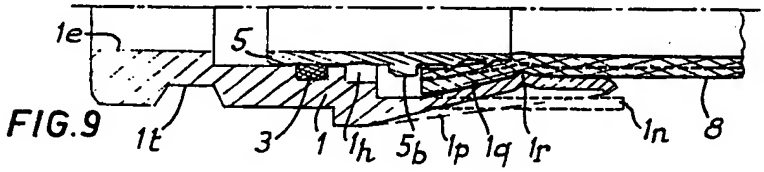


FIG.9

FIG.10

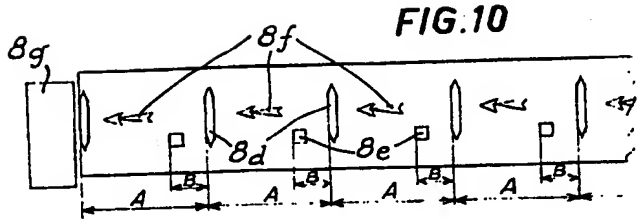


FIG.11

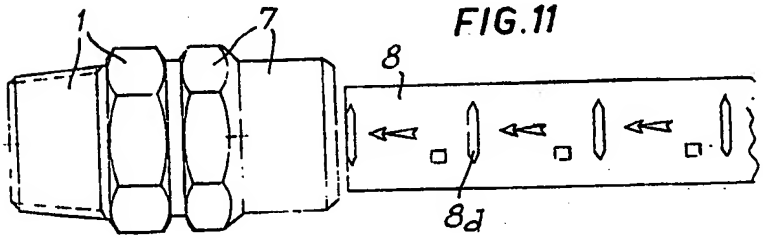


FIG.12

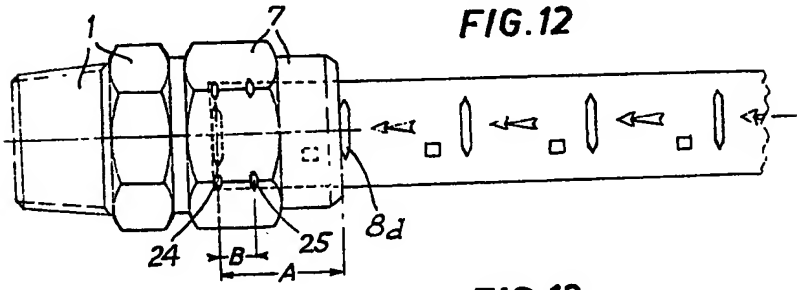


FIG.13

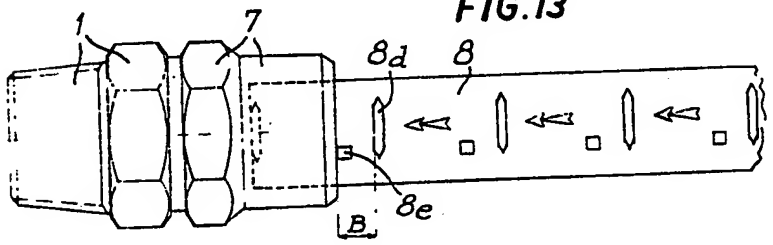


FIG-14

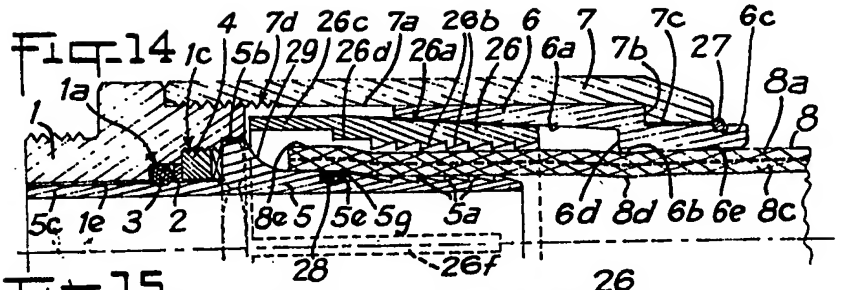


FIG-15

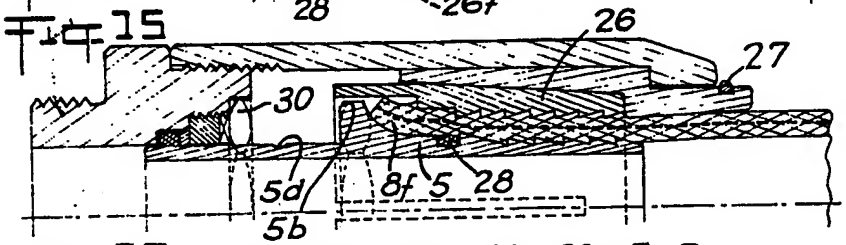


FIG-16

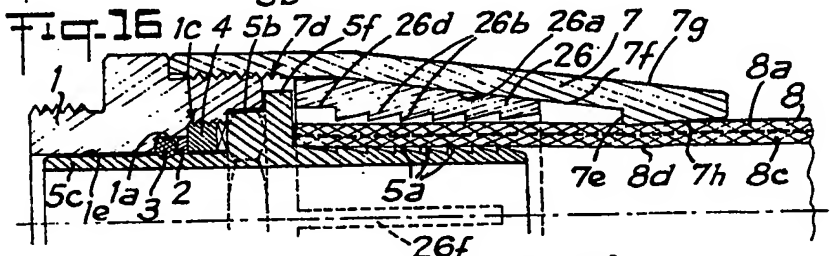


FIG-17